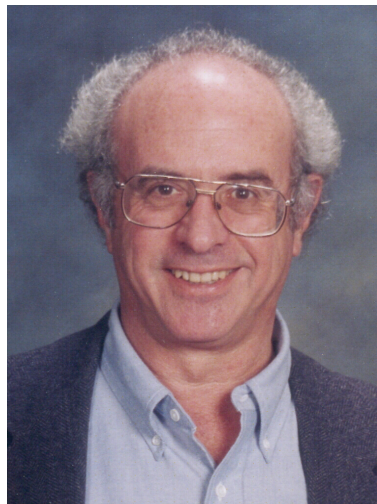# Information Science and Technology Center Seminar

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"State and Parameter Estimation in Models of Nonlinear Systems"

Wednesday, February 24, 2010
3:00 - 4:30 PM
TA-3, Bldg. 1690, Room 102 (CNLS Conference Room)

Abstract: The problem of using observed information in estimating unobserved state variables and fixed parameters in a model of a nonlinear dynamical system when the measurements are noisy, the model has errors, and the state of the system as measurements begin is uncertain is cast as an exact path integral. In this formulation the measurements are seen as a guiding "potential" directing a chaotic system to the correct region of phase space. The path integral is evaluated directly for small systems such as the Lorenz 1996 model. In the measurement window, there are indications that the distribution of state variables is nearly Gaussian. The properties of the path integral can yield an approximation to the number of required measurements.

A saddle point evaluation of the path integral is seen to be 4DVAR, and implementing this in the case where the dynamics is error free—i.e. deterministic—is shown to require regularization to achieve a smooth surface on which the estimation search can proceed. The number of observations required to regularize the search can be estimated from this requirement.

The regularized 4DVAR method is applied to experiments on a small nonlinear circuit as well as to the Lorenz 1996 model.

Biography: Henry Abarbanel received his B.S. in physics from Caltech and his Ph.D. in physics from Princeton University. He has served on the faculties at Princeton, Stanford, Northwestern, the University of Chicago, UC Berkeley, UC Santa Cruz and, since 1982, at UC San Diego. He also holds an appointment as a theoretical physicist at the Fermi National Accelerator Laboratory. He presently has appointments as professor of physics at UC San Diego and research physicist at the Marine Physical Laboratory, Scripps Institution of Oceanography. His research interests have ranged from elementary particle physics to the nonlinear dynamics of biological and physical systems. In that regard he was the founding director of UC San Diego's Institute for Nonlinear Science and served from 1986 through 2007. In 2000–01 he served as a member of the University of California's Academic Council, the governing body of UC's faculty senate. Since 1974, Abarbanel has been a member of JASON, a consulting group to the U.S. Government on technical matters. In 1992 he became a member of the City Council of Del Mar, California, serving as mayor in 1995–96. In that role he has served on numerous regional bodies concerned with energy, wastewater, infrastructure, and quality of life in the San Diego region.

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